Temperature and Pressure Effects on Thermal Conductivity of Zinc Sulfide

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In the present work the thermal conductivity, κ, of zinc sulfide has been investigated from 80 to 400 K and under hydrostatic pressure up to 3.5 GPa. The simple structure of ZnS has made possible an interpretation of the experimental results. The investigated polycrystalline samples were prepared by means of a vacuum recrystallization pressing. A relative density of the samples reveals that 0.998 of the density of ZnS is monocrystal. Its grain dimensions is 1-2 microns.

The lattice thermal conductivity, κ_{ph}, is main mechanism of thermal transfer for ZnS of all investigated temperatures and pressures. The temperature dependence of the thermal conductivity indicates the absence of photon thermal conductivity at given temperatures, and calculations confirm that. The value of κ_{ph} of the monocrystal exceeds κ_{ph} of the polycrystal considerably. The lowering of the κ_{ph} of polycrystalline samples is bound with phonon scattering by the grain boundaries and intergrain defects.

The experimental data show that the increasing of pressure leads to the increasing of thermal conductivity of ZnS. That can be explained by the increasing of Debye temperature and the decreasing of Gruneisen parameter. The pressure effect on temperature dependence of lattice thermal conductivity has been considered. Index n in the dependence $\kappa_{ph} \sim T^{-n}$ changes with pressure. The n change can be explained by the change of the value $\xi = C_{11}/C_{44}$ because in cubic crystals there is a correlation between n and ξ, and C_{11} depends stronger on pressure than C_{44}.